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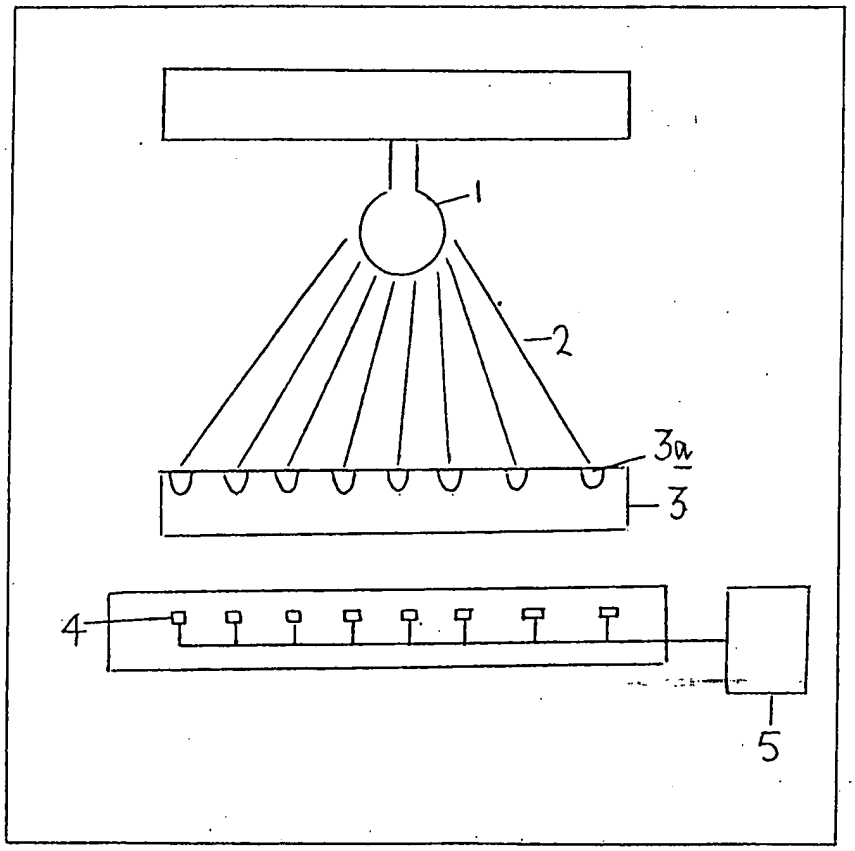
(54) Opacity measurement apparatus and method

(57) Apparatus and method for automatically detecting the increase in opacity of a liquid in a container 3*a* by shining a light 1 through the liquid onto a photo-electric cell 4, the cell output being automatically monitored. Useful for detecting the growth of micro-organisms in a well in a transparent multi-well plate, 3. Light may be distributed from a common source 1 by light guides 2 to respective wells 3*a*, the optical transmission being measured by respective photo-electric cells 4. The optical transmission of a well containing a test material may be compared with that of a well containing a control material by arranging relative motion between the wells and a combination of a common source and photocell, so as to provide sequential measurements.



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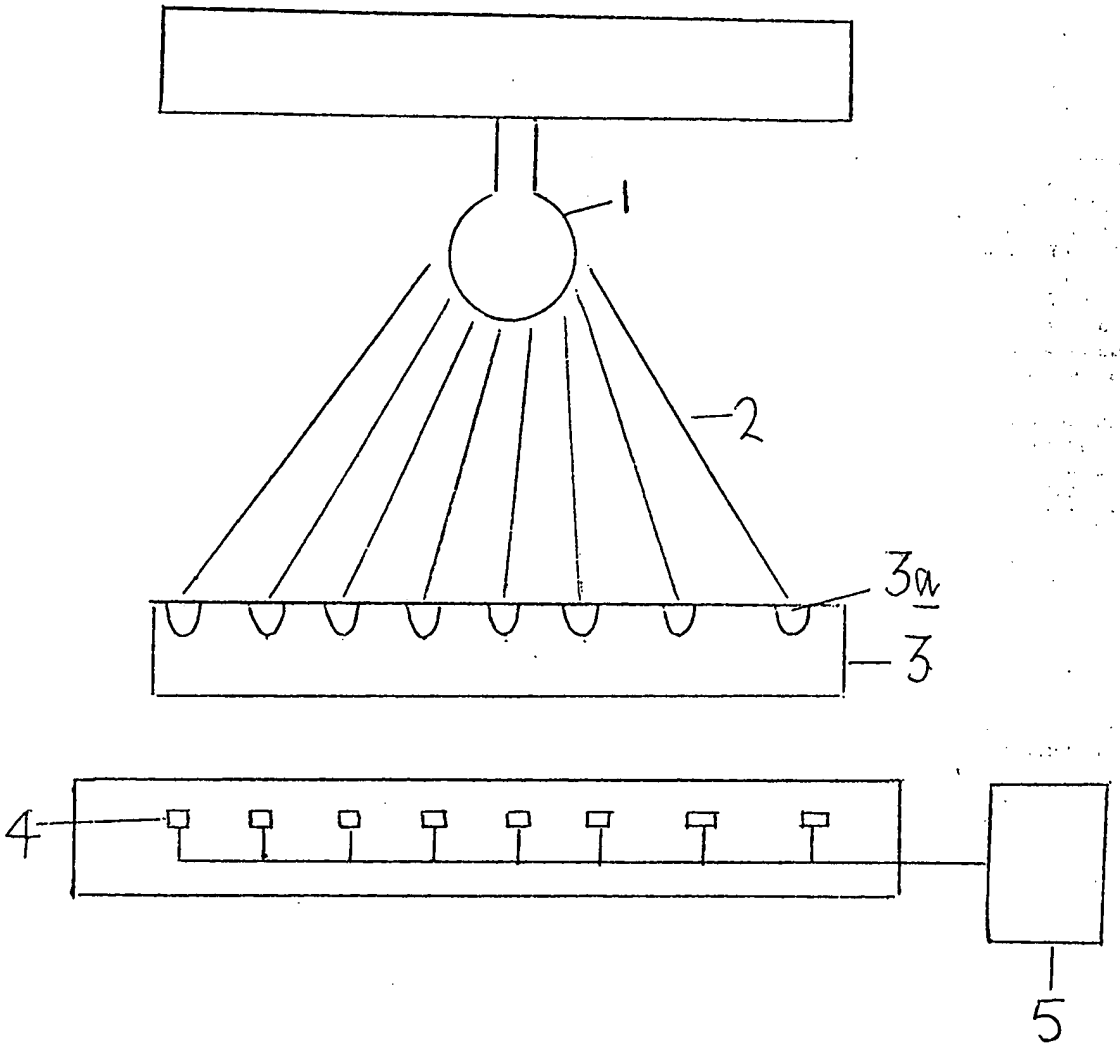

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SPECIFICATION

Test method

This invention relates to an apparatus and method useful for assessing the effectiveness of various drugs against micro-organisms.

It is known to have a multi-well plate in which there are a series of lines of wells which can be used in testing for the effectiveness of drugs against micro-organisms. In use the wells and innoculated with a micro-organism culture and a known concentration of a drug, the wells in each line having a different concentration of drug, and each row of wells having a different drug in them. By observation of the wells in which there is a growth of the micro-organism culture and the wells where there is no growth of the micro-organism culture it is possible to ascertain the minimum concentration of each drug which is effective, against the micro-organism, usually the micro-organisms are pathogenic.

This method relies on the observation by a trained operator which can lead to errors in observation both by the same operator and as between different operators. It also requires the writing down of the results by the operator which can be time-consuming and can also lead to errors. We have now devised an apparatus and method which can enable automatic assessment of the growth or non-growth of a micro-organism in a well in a multi-well plate to be determined and which can be readily adapted for automatic print-out of the results and which can be used in conjunction with a micro-processor to print-out the results in the most relevant way for the operator.

According to the invention there is provided a method of determining if there is a reduction in the transmission of light passing through liquid in a container which method comprises shining a light from a light source through the container picking up the light transmitted through the container by means of a photo-electric cell and using the output from the photo-electric cell to indicate whether there is a reduction in transmission of light through the container.

The invention works by converting the absorption of light on its passage through liquid in a container into a reduction of the output of a photoelectric cell. By having a reference container containing a reference liquid it is possible to indicate whether the reduction in light transmitted is beneath a certain value.

The method can be used to measure the degree of turbidity in a liquid, the relative value of suspended solids, or the degree of colour in a liquid. The invention is especially useful for detecting whether there is growth of a micro-organism in a cell in a multi-well plate.

The light source can cause light to shine through the wells in the multi-well plate to be received by an array of photo-electric cells placed the other side of the wells from the light source. A convenient way of accomplishing this is to have a single light source and light guides passing from the light source to the wells in the multiwell plate. On the other side of the wells are positioned an array of photo-electric cells which can receive light passing through the wells.

Alternatively the light source and photo-electric cell can move relative to the well so that it is possible to compare the amount of light transmitted through a control well with that transmitted through the well being tested in order to eliminate errors due to faults or variation in the light source or photo-electric cell. In a preferred embodiment of the method of invention there is a mulit-well plate having a plurality of rows of wells each containing a micro-organism culture, each row having a sequential increase in concentration of a drug from well to well in that row, and each row containing a different drug, placed on a suitable support, the light source causes light to shine through the wells to be received by the photo-electric cell, and an output based on the light transmitted through each well is obtained. Preferably, there is a control row of cells with no drug in it so that a control reading can be obtained. A suitable method for converting the output from the photo-electric cell into a form which can be readily recognised by an operator is to process the out-put through a circuit in which, if the output is above a certain level a 'yes' signal is obtained, and if it is below a certain level a 'no' signal is obtained. By connecting the out-put to a machine which can convert the 'yes' and 'no' signals into written form the operator can have a permanent record of the results of the testing of the plate.

The information obtained is especially suitable for processing through a pre-programmed micro-processor which can enable other information concerning the plate being tested to be fed into the micro-processor along with the outputs from the photo-electric cell. This facility enables a more useful print-out to be obtained.

Passing the out-put through a micro-processor would also enable various errors to be noted and the operator's attention drawn to them e.g. no growth at one level of drug and growth at a higher level of the same drug.

Other information about a plate can be fed into the micro-processor by sticking a label on the side of the plate with the information on it in a machine readable form which can be read by an attachment to the light source, photo-electric cell system or by any other suitable system. The micro-processor can also have stored in its memory other information relevant to the information it is desired to learn from the multi-well plate. By attaching a key-board to the micro-processor, the micro-processor can be interrogated.

A commonly required parameter for a micro-organism is its Minimum Inhibition Concentration Level (MICL) towards a series of drugs, and by programming the micro-processor with a suitable program and with a suitable print-out it is possible to obtain in written form details of the (MICL) of a range of drugs with respect to the micro-

organisms.

The invention also provides apparatus for determining if there is a reduction in the transmission of light passing through liquid in a container which apparatus comprises a support for the container, a light source able to shine a light through the container and a light actuable receptor, e.g. photo-electric cell positioned so that light from the light source shining through the container is received by the light actuable receptor.

Preferably the light source can shine over a plurality of containers in rows and an output is obtained from the light actuable receptor which depends on the amount of light transmitted through the container.

There can be connected to the light actuable receptor an indicator which will produce an operation e.g. cause a light to flash or a print-out machine to make a certain mark when the output from the light-actuable receptor is above a certain value and produce a different operation when the output is below a certain value.

In order to obtain more detailed information the output from the light actuable receptor can be fed into a pre-programmed micro-processor which can then print out the required information, also there can be connections between the micro-processor and the rest of the equipment so that the micro-processor can control the operation of the equipment. This facility enables a key-board to be attached to the micro-processors for interrogation of the micro-processor to take place.

It could be required to feed information into the micro-processor from the plate, and the apparatus can then include suitable reading means whereby it can read information attached to the plate in a suitable form and transmit this information to the micro-processor.

In order to enhance the differentiation in light being transmitted by different containers there can optionally be present means to allow coloured slides to be placed between the light source and light actuable receptor either above or below the multi-well plate.

Preferably the container support is adapted to support a multi-well plate and there is an array of photo-electric cells positioned so that when a multi-well plate is placed on the support there is a photo-electric cell beneath each well in the plate.

The light can suitably be passed from the light source to the containers by means of light guides which can be incorporated in the apparatus, so that, when the container for which the apparatus is designed, e.g. a multi-well plate is placed onto the container support the light guides terminate at a suitable position.

The invention is further described in the accompanying drawing in which 1 is a light source, from which light guides 2 lead. The light guides terminate in a postion directly above each well in multi-well plate 3, directly beneath each well in multi-well plate 3 are photo-electric cells 4.

In operation each row of wells in the plate 3 except the last row 3a, has a micro-organism culture in it together with a drug which differs from row to row.

In each row the concentration of the drug varies sequentially.

The light source 1 is turned on and light passes down light guides 2 and thence through the wells in the multi-well plate 3 to the photo-electric cells. In the wells in which there is growth of the micro-organism less light passes through the well, the photo-electric cell receives less light and consequentially gives out a weaker signal. The output from the photo-electric cells is in convenient form to be fed to a micro-processor 5 for display and recording.

CLAIMS

1. A method of determining where there is a reduction in the transmission of light passing through liquid in a container, which method comprises shining a light from a light source through the container picking up light transmitted through the container by means of a photo-electric cell and using the output from the photo-electric cell to indicate where there has been a reduction in the transmission of the light.

2. A method as claimed in claim 1 in which the container is a multi-well plate.

3. A method as claimed in claim 2 in which there is an array of photo-electric cells positioned beneath at least some of the wells in the multi-well plate and the light is passed from the light source along glass light guides to above the wells in the mulit-well plate.

4. A method as claimed in claim 2 or 3 in which there is a multi-well plate having a plurality of rows of wells each row containing a micro-organism, and the wells in each row containing a drug which is in a concentration which varies sequentially along the row, the light from the light source is shone through the wells the light received by the photo-electric cells positioned beneath the wells, and out-puts are received from the photo-electric cells based on the amount of light transmitted through the wells.

5. A method as claimed in any one of claims 1—4 in which the output from the photo-electric cell is passed to a pre-programmed microprocessor to be read by an operator or printed.

6. Apparatus for determining if there is a reduction in the transmission of light passing through a container which apparatus comprises a support for the container, a light source able to shine light through a container placed on the support and a light actuable receptor placed beneath the container so that light from the light source can pass through the container to the light actuable receptor which gives an output dependent on the light transmitted through the container.

7. Apparatus as claimed in claim 6 in which the light is passed from the light source to the container placed on the support by glass light guides, and there is a photo-electric cell positioned beneath the container support able to

receive light passing through the container.

8. Apparatus as claimed in claim 6 or 7 in which there are more than one light actuable receptors able to be operated by light passing through more than one container.

9. Apparatus as claimed in claim 8 in which the container support is able to support a multi-well plate and there is an array of photo-electric cells positioned so that they are able individually to receive light passing through wells in the multi-well plate.

10. Apparatus as herein described with reference to the accompanying drawings.

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